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ABSTRACT: The relationship between croup and the presence of household cigarette consumption was assessed in a matched-pair case control study. Fifty subjects with a primary hospital discharge diagnosis of croup were paired with children with a primary hospital discharge diagnosis of abdominal hernia. The results yielded an estimated relative risk of 0.82. The power of this study to detect a relative risk of 2.0 was 38%. This study fails to show a relationship between passive smoking and croup in early childhood.

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Passive Smoking and Croup

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• The relationship between croup and the presence of household cigarette consumption was assessed in a matched-pair case control study. Fifty subjects with a primary hospital discharge diagnosis of croup were paired with children with a primary hospital discharge diagnosis of abdominal hernia. The results yielded an estimated relative risk of 0.82. The power of this study to detect a relative risk of 2.0 was 38%. This study fails to show a relationship between passive smoking and croup in early childhood.

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The deleterious effects of cigarette smoking on health are well established. The health effects of passive smoking remain a more controversial topic. *Passive smoking* is the involuntary exposure of tobacco combustion products to nonsmokers from the smoking of others. The small child is particularly vulnerable to passive smoking exposure from household members. There are many studies in the literature linking parental cigarette smoking to respiratory tract infections in children. Studies about the effects of passive cigarette smoking in children have shown the following: (1) increased frequency of lower

respiratory tract infections, especially bronchitis and pneumonia, in infants younger than 1 year^{1,2}; (2) increased respiratory syncytial virus infection^{3,4}; (3) exacerbation and increased risk of asthma and the atopic state^{5,6}; and (4) reduced lung function in older children detected through spirometry.^{7,8}

The relationship between parental smoking and croup has not received much attention in the literature. Lebowitz and Burrows⁹ reported that there was no significant difference in the prevalence rate of croup (as well as bronchiolitis and pneumonia) between children of smokers and nonsmokers; however, no data were presented. Gardner et al¹⁰ also found no association between croup and parental smoking. Their data only mention the total number of episodes of croup in a group of children with parents who smoke compared with the total number of episodes of croup in a group of children with parents who do not smoke. The data do not reveal what percentage of each group of children suffered from croup.

There have been studies linking maternal smoking to the atopic state in children⁶ and exacerbating asthma in children.⁶ Because spasmodic croup, a common form, may be associated with an allergic state,^{11,12} it may also be influenced by passive smoking. The risk for viral and spasmodic croup may increase with parental smoking. Respiratory syncytial virus infection was linked to parental smoking in several studies.¹³ Respiratory syncytial virus accounts for up to 12% of

viral croup cases in some investigations.¹⁴

Although there were several studies^{12,15} that found no relationship between parental smoking and croup, these studies either presented no data or questionable data. The following study is done to demonstrate whether a relationship between passive smoking and croup exists.

SUBJECTS AND METHODS

The population under study consisted of children younger than 5 years who were discharged from the Mount Sinai Hospital in New York City between 1979 and 1985. The majority of the patients (58% of the study population) are black and Hispanic and from lower socioeconomic classes.

A matched-pair case control study was done. Telephone numbers were obtained from the medical charts of patients in the target population who had primary hospital discharge diagnosis of croup or abdominal hernia. Data were then collected through telephone interviews. Data from croup subjects were collected first and then appropriate hernia subjects were chosen to obtain matched pairs. Criteria for match-pair selection were as follows: (1) same ethnic group (white, black, or Hispanic), (2) hospital admission dates within one year of each other, and (3) age (either younger or older than 1 year). Ethnic group was controlled because of the different prevalence rates of smoking among these different groups (whites less than blacks and Hispanics). All 50 pairs fell into one of these three different groups. Hospital admission dates were controlled since the overall prevalence of smoking in the population decreased between 1979 and 1985. One croup subject could not be matched with this criterion and was sube-

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quently matched with a hernia subject admitted 18 months later rather than within 12 months. Age was also used as a criterion because many studies¹³ have only shown a relationship between passive smoking and respiratory illnesses in children younger than 1 year.

The mother of the subject was sought for the telephone interview but if not available, information was taken from a household member. The questions asked were as follows: (1) Who took care of the child in the months preceding the hospitalization? (2) Who smoked cigarettes during this time? (3) In which ethnic group do the parents consider the child?

Only cigarette smoking was included. Questions about pipe, cigar, and recreational smoking were not asked, although these may be important contributing factors.

There were 169 children younger than 5 years with a primary hospital discharge diagnosis of croup between 1979 and June 1985. All of these charts were requested and 147 of these were received from the Medical Records Department. One hundred twenty-four of these charts contained telephone numbers; 65 of these numbers were either wrong or disconnected. No answer was obtained with eight after calling between five and ten times at different times of different days. Fifty-one households were reached by telephone. One refused to participate, leaving a sample size of 50 subjects.

The target population consisted of 370 children with a primary hospital discharge diagnosis of abdominal hernia. Our request for all of these charts produced 312. Two hundred sixty-five had telephone numbers. Date of hospital admission and age were the two criteria used in determining which hernia subject would be used when more than one appropriate case was available. The closest matched subjects for these two criteria were called first. One hundred twelve hernia subjects needed to be called to obtain the 50 matched subjects. There were 61 wrong or disconnected numbers and one no answer.

RESULTS

Each subject was first classified as either living in a home with at least one cigarette smoker or living with no cigarette smokers. The 50 matched pairs fall into the categories as shown below:

	Croup	
	Smokers	No Smokers
Hernia Smokers	15	11
No smokers	9	15

There are actually more pairs with the croup subjects in the homes with no smokers and hernia subjects in the homes with smokers than the converse. The estimated odds ratio is less than one (9/11 or 0.82), which is not significant ($\chi^2 = 0.80$ and must be greater than 3.841 when $\alpha = .05$). Since there are only 20 discordant pairs among the 50 pairs shown, the power of this study to detect a twofold increased risk is only 38%. A 2.0 relative risk is approximately the increased risk found in most studies¹³ linking parental cigarette smoking to bronchitis and pneumonia in children, although the most recent Surgeon General's report states that children of smokers had a 20% to 80% greater risk of respiratory problems than other children.¹⁴ Therefore, the power of this study may even be less than 38%.

The literature¹ has shown the effect of maternal smoking as more important than parental smoking in increasing the risk for respiratory illnesses in children. This requires investigation of maternal smoking as an isolated factor. These results are shown in the following:

	Croup	
	Maternal Smokers	Maternal Nonsmokers
Hernia Maternal smokers	5	12
Maternal nonsmokers	8	25

Once again we see more pairs with maternal smokers for patients with hernia and maternal nonsmokers for patients with croup than the converse. The estimated odds ratio equals 0.67.

Many studies¹³ show only children younger than 1 year at an increased risk for developing a respiratory illness from passive smoking. Therefore, children younger than 1 year are categorized separately. The results are shown below:

	Croup	
	Smokers	No Smokers
Hernia Smokers	5	5
No smokers	2	7

Nineteen pairs contained children younger than 1 year. We again have an estimated odds ratio of less than one (0.40).

The following shows the results when only maternal smoking is examined with children younger than 1 year. The estimated odds ratio is exactly 1.

	Croup	
	Maternal Smokers	Maternal Nonsmokers
Hernia Maternal smokers	2	3
Maternal nonsmokers	3	11

Each interviewee was also asked who took care of the child during the day in the months preceding the hospitalization. This was asked because this person probably had the greatest contact with the child and this person was sometimes not the mother. The following shows the results when the smoking history of this caretaker is examined separately. The estimated odds ratio is less than 1 (0.90).

	Croup	
	Smokers	Nonsmokers
Hernia Smokers	3	10
Nonsmokers	9	28

The following shows the results when the smoking history of the caretakers and only children younger than 1 year are examined.

	Croup	
	Smokers	Nonsmokers
Hernia Smokers	1	3
Nonsmokers	4	11

The estimated odds ratio is 4/3 or 1.33. The difference is not significant.

COMMENT

Data do not support the hypothesis that passive cigarette smoking increases the risk for croup in young children. The power of this study does indicate that the study population may not have been large enough. When we examine the 50 pairs of subjects, there were only 20 discordant pairs in the analysis involving the presence of household smokers. This does not furnish sufficient statistical power for this study. Most studies¹³ finding an association between parental smoking and bronchitis and pneumonia only found about a twofold increased risk. If the risk for croup is increased by parental smoking, then the increased risk is

probably about twofold as it is for bronchitis and pneumonia. We need 55 discordant pairs to achieve a statistical power of 80%. The statistical power is only 38% with 20 discordant pairs.

Another limitation of this study is that the target population only includes children who were hospital-

ized for croup. Because croup is predominantly an outpatient disease, the population under study may not be a representative sample of children afflicted with croup.

The literature¹⁻¹¹ has shown that parental smoking can adversely affect the health of children. Although this study does not support the hypothesis

that passive smoking increases the risk for croup, the power of this study is too small to draw conclusions. A larger study is warranted.

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Editorial Footnote

This interesting epidemiologic pilot study contains important new scientific information and provides an opportunity to review and relearn some valuable features and some limitations regarding survey research of this type.

One of the disappointing aspects of the report is the absence of data regarding the amount of smoking activity to which the child was exposed. Other reports dealing with the direct effect of smoking on individuals have been careful to include quantitative information describing the amount of smoking that has occurred. If one is investigating a particular cause-and-effect relationship, the dosage (number of cigarettes smoked) of the supposed causative

factor is a central issue to validity and reliability as one deals with conclusions regarding the effects.

Even though this particular report contributes no valid scientific information concerning the risk of passive smoking, the authors have introduced a research methodology that, under appropriate circumstances, has the capability of detecting such effects. The authors certainly did the right thing, but, unfortunately, the limits of the study did not result in a definitive outcome from the sample that was used. The ultimate purpose of this study was to demonstrate whether a relationship exists between passive smoking and croup. The results permit no accurate determination

of the strength of this relationship. The Surgeon General's office now reports a definite association between passive smoking and respiratory disease in infants. If my understanding of the Surgeon General's report is correct, then I suggest that the authors are accurate when they propose that a broader study should definitely be designed and funded. Having said all of this about the shortcomings of the study, I hasten to congratulate the authors for having undertaken such a difficult task and for having accomplished as much as possible within the limitations of their resources.

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Chief Editor

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